How to ride a motocross track most efficiently?

By: Sawyer Schell

Introduction:

My name is Sawyer Schell, I am 11 years old, in grade 6, and attend St. Joan Arc School. My passion is motocross. A sport that is fun and combines human and machine. I have raced motocross since I was 3 years old. I won a few championships, including the Western Canadian Championship in my age class, and want to keep getting faster.

Last year my science fair project was focussed on the machine. How to make a dirt bike more efficient? The more efficient the dirt bike is, the faster you can ride it. This year I want to focus on the human. How can I ride a motocross track most efficiently?

I will do this by:

- Studying many race track designs, and learning the science behind the different obstacles. If I can understand the science behind the tracks, maybe I can plan ways to ride faster?
- Research ways to ride each obstacle most efficiently. Are there riding techniques that are more efficient than others, to help go faster?

Hypothesis:

I think there are some common components to motocross tracks because they all have similar concepts and obstacles. I think there are ways to ride tracks most efficiently with riding techniques and strategies that the racer can learn and improve with practice.

Track Designs

Let’s learn about track designs and see if there are any common scientific principles.

What are the different track designs and most common obstacles? I need to make a list of all the different soil types and obstacles, then find out which ones are the most common. Once I know the most common obstacles, then I can study how to ride them most efficiently.

In 9 years I have ridden and raced a lot of different tracks across Canada and the USA. Each track is different, but they all have similar obstacles. Here is a chart of 29 different tracks I have ridden, and the most common soil types and obstacles.

Most Common Obstacles

STARTS:
Straight aways: Starts are usually a long straight away.

CORNERS:
Corners with ruts, and corners without ruts.

Tight Corners with ruts: slower speed sharp corners, usually 180 degrees, with a rut made by many dirt bikes riding in the same line. The pushing forces of the bike and rider in the same spot makes the ruts.
Tight corners without ruts: slower speed sharp corners, usually 180 degrees, flat with no ruts or berms.
Sweeping corners with ruts: high speed gradual corners, usually between 90 and 180 degrees, with ruts,
Sweeping corners without ruts: High speed gradual corners, usually between 90 and 180 degrees with no ruts

JUMPS: Jumps are mostly solid structures that are made with piles of dirt. Sometimes they are human built structures, and sometimes they are natural structures like small hills. Track crews make these jumps with heavy equipment. Sometimes jumps are made as a frame structure, like the mountain's edge jump at the Calgary track. They built a large jump with a tunnel underneath.
Singles: One mound of dirt. A single jump usually landing on flat ground.
Doubles: Two mounds of dirt. One jump face with a landing far away, and a gap in between.
Triples: Three mounds of dirt. One jump face with a landing far, and another mound of dirt in between the gap. You can double it, or triple it.
Table tops: A large mound of dirt that has a jump face and a landing. The gap is filled in so it looks like a table.
Wall jumps: One mound of dirt, like a single. But very tall and very steep.

WHOOPS:
Rollers: Many mounds of dirt spaced near each other with rounded, rolling edges.
Supercross whoops: Many mounds of dirt spaced very close together with sharp, steep edges.

Track	Straights	Corners	Jumps	Whoops
Calgary, AB	✓	✓	✓	✓
Brooks, AB	✓	✓	✓	✓
Medicine Hat, AB	✓	✓	✓	✗
Drumheller, AB	✓	✓	✓	✓
Irricana, AB	✓	✓	✓	✗
Taber, AB	✓	✓	✓	✓
Raymond, AB	✓	✓	✓	✗
Coulee Springs, AB	✓	✓	✗	✗
Alix, AB	✓	✓	✓	✗
Thorne Valley, AB	✓	✓	✗	✗
Revelstoke, BC	✓	✓	✓	✗
Kamloops, BC	✓	✓	✓	✗
Popkum, BC	✓	✓	✓	✗
Invermere, BC	✓	✓	✓	✓

OBSTACLES: DIFFERENT TRACKS THAT I HAVE PERSONALLY RIDDEN

Tata Creek, BC	✓	✓	✓	✓
Elko, BC	✓	✓	✓	✗
Kent, Washington	✓	✓	✓	✗
Bremerton, Washington	✓	✓	✓	✗
Grays Harbour, Washington	✓	✓	✓	✗
Port Angeles, Washington	✓	✓	✓	✗
The Ridge, Washington	✓	✓	✓	✗
Washougal, Washington	✓	✓	✓	✓
Hanigan, Washington	✓	✓	✓	✗
Milestone, California	✓	✓	✓	✗

Common obstacles Continued

Most common obstacles continued

	STRAIGHTS	CORNERS	JUMPS	WHOOPS
Murrieta, California	✓	✓	✓	✓
ACP Phoenix, AZ	✓	✓	✓	✗
Motoland, Phoenix, AZ	✓	✓	✓	✓
Portland, Oregon	✓	✓	✓	✓
Kahuku, Hawaii	✓	✓	✓	✓

Total: Straights: 29 Corners: 29 Jumps: 27 Whoops: 12

Most common obstacles continued

The most common obstacle on a motocross track are straights and corners, because all 29 tracks have them. 2 of the tracks didn’t have jumps because they are more natural terrain with speed sections and rolling hills with corners. Whoops are not very common because only 12 tracks had them. I need to practice the most popular obstacles because they are on more tracks. I also need to practice whoops because I don’t get to do them very often because they don’t have them at the Calgary track.

SOIL TYPES:

Now let's study the soil types:

DIFFERENT SOIL TYPES:
Hard packed: This is hard packed ground. Clay is usually hard packed.
Loam: Loamy, earthy, fluffy dirt, sometimes mixed with black soil.
Sand: Sand like at a beach.
Silt: A mixture of sand, clay, loam, with similar characteristics as sand.

MOISTURE:
Moisture depends on the weather conditions, or the preparation of the track.
Dry: Motocross tracks are usually very dry, unless it's raining, or unless it's prepared (prepped) by a track crew.
Wet: Motocross tracks are wet when it's raining, or when it's just been prepared (prepped) by a track crew with a watering system.
In between (just right): This is when the dirt has some moisture and is tacky, grippy, and not dusty.

SOIL COMPOSITION: DIFFERENT TRACKS THAT I HAVE PERSONALLY RIDDEN

Track	Clay	Loam	Sand	Silt	Rock/gravel
Calgary, AB	✓	✓	✗	✓	✗
Brooks, AB	✓	✓	✗	✓	✗
Medicine Hat, AB	✓	✗	✗	✗	✗
Drumheller, AB	✓	✗	✗	✗	✗
Irricana, AB	✓	✗	✗	✓	✓
Taber, AB	✓	✗	✗	✓	✗
Raymond, AB	✓	✗	✓	✓	✗
Coulee Springs, AB	✓	✓	✗	✗	✗
Alix, AB	✓	✗	✗	✗	✓
Thorne Valley, AB	✓	✓	✗	✗	✗

Soil Composition continued

Revelstoke, BC	✓	✗	✗	✓	✓
Kamloops, BC	✓	✓	✗	✓	✗
Popkum, BC	✓	✗	✗	✗	✓
Invermere, BC	✓	✗	✗	✗	✓
Tata Creek, BC	✓	✗	✓	✓	✗
Elko, BC	✓	✗	✗	✓	✓
Kent, Washington	✓	✓	✗	✗	✓
Bremerton, Washington	✓	✗	✗	✓	✓
Grays Harbour, Washington	✓	✓	✓	✓	✓

Port Angeles, Washington	✓	✗	✗	✗	✓
The Ridge, Washington	✓	✓	✗	✗	✓
Washougal, Washington	✓	✓	✗	✗	
Hanigan, Washington	✓	✓	✗	✗	✓
Milestone, California	✓	✓	✗	✓	✗
Murrietta, California	✓	✗	✓	✓	✗
ACP Phoenix, AZ	✓	✓	✗	✓	✗
Motoland, Phoenix, AZ	✓	✗	✗	✗	✗
Portland, Oregon	✓	✓	✗	✗	✗
Kahuku, Hawaii	✓	✓	✗	✗	✗

Soil Composition continued

Total: Clay: 29 Loam: 14
Sand: 4 Silt: 14
Rocks/Gravel: 12

Soil composition continued

Out of the 29 tracks, they all have clay, 14 have loam, 4 have sand, 14 have silt, and 12 have rocks/gravel. The least amount of practice I get is in sand so I want to practice it more.

Now that I understand the various types of soil composition and obstacles of a motocross track, now I have to study riding techniques and how the different types of forces apply. Let's review the different forces.

Forces

Frictional Force: When an object moves across another surface, the surface is creating a force to slow down the object.

Tension Force: A force that happens when a rope, string, cable, or wire is pulled in each direction. I can't think of anything related to riding technique for this. But I can think of tension forces on the bike. For example, the chain driving the wheel from the sprockets, or the throttle cable lifting the needle in the carburetor when you twist the throttle. But this science fair project is not related to the mechanics of the bike.

Normal Force: When one object is being held up or supported by another object that has the same amount of force.

Air Resistance Force: When something is travelling through the air, and the air resists the movement of the object.

Applied Force: When a person or some kind of object or machine pushes something by applying force.

Spring Force: When a force is made by compressing or stretching a spring.

Gravitational Force: A downward force toward the center of the earth.

Forces continued

Forces	Straights	Corners	Jumps	Whoops
Frictional Force	Tires contact dirt.	Tires contact dirt.	Tires contact dirt on face and landing.	Tires contact top of whoops.
Riding Technique	Lean weight back so the rear wheel has traction.	Place your weight forward on the front of the bike so the front tire has traction. Lift your inside leg to add more weight to the front of the bike. Push your weight on the outside foot peg so your rear tire has traction.	If the jump face is wet or slippery, you should be gentle on the throttle so you don't slide out. On landings you keep your weight balanced so you stay stable.	Lean your weight back and keep a steady throttle through all the whoops, so you keep your front wheels high so you don't endo or nose dive. Sometimes you drag your rear brake to make friction on the rear wheel, so your back wheel stays straight.

Forces continued

	Straights	corners	jumps	whoops
Normal	Keeping your weight back and grip your knees into the side of the bike because the to hold against the forward force of the motorcycle. You don't have to grip too tight because the bike moves underneath you and you want to ride the bike, you don't want the bike to ride you.	When there are ruts the rut pushes against the force made by the bike and my body. So I can ride this faster without falling over and keep my body in the centre of the seat but toward the front of the bike. When there are no ruts you place your body over the side of the seatso your weight is more upright up and down, but you can still lean your bike over sideways. Keep a smooth throttle.	When the jump face is hard packed your bike and body normal force is supported by the jump face. This is easier because you can predict what's going to you and your bike. But if the soil composition is soft, like sand or mud, or loam, you can't predict what might happen to your bike in the air so you have to be ready to move in the air. The normal force of the landing also because when you land in soft dirt it absorbs the landing more than hard dirt.	Whoops can be unpredictable if you don't have proper form because the force of your bike and body will get bounced around and could make your bike go sideways and crash. Keeping light on your bike to lower the normal force is best.

	Straights	corners	Jumps	whoops
Air Resistance	On straights if you stand up straight there will be a lot more air resistance because your body is in the way of the air. To avoid lots of air resistance you should move your body over your rear fender and then lean forward so there is not as much air resistance.	Air resistance does not really affect you in corners so you don’t need to worry about it.	Air resistance affects you in the air but if you move your body to stop it then it will affect your bike control and you may crash.	In the whoops air resistance affects you a little bit so you should place your weight over your rear fender and lean forward while keeping a steady throttle.
Applied Force	There is applied force on straits and if you place your weight over the back fender it will make more force for more speed which means more speed.	In corners you use applied force to put traction on your front wheel and you can do this by placing all of your weight on your front fender and sticking your inside leg forward which adds weight and this applies force which gives you front end more traction.	On jumps you want to apply as much force as you can on the takeoff of the jump because that gives you the most traction which makes you get the most power off the takeoff so you can jump further.	In whoops you want to apply as much force as you can on the tops of the whoops so you have enough traction to lay lots of power down to skim through the whoops faster.

	Straights	corners	jumps	whoops
Spring Force	On straightaways spring force does not affect you so you do not need to worry about it unless there are speed bumps then you need to have proper form to help the suspension. You can bend your knees and use your legs and body to absorb some of the force.	In corners spring force does not affect you. But if your suspension is not set up right the bike might not sit property in corners.	On the takeoffs of some jumps you want to lean back and sit so all of your weight compresses the back spring so it will spring up when you take off so you can jump further. Seat bouncing is a technique that helps you get more pop on a jump so you can go higher and farther. You sit down on a jump face so you apply lots of spring force to the rear suspension. Gravitational force also pushes you and your bike into the jump face harder using this technique. So your rear suspension bottoms out on the face of the jump, then it rebounds at the top of the jump to give you extra lift.	In whoops you need to be leaning back to help cooperate with you suspension to make it a smooth ride and so you can ride through them faster and more efficiently

	Straights	corners	jumps	whoops
Gravitational Force	The heavier you and your bike are, the more traction your rear tires gets, but then you might not be able to go as fast because you're using too much power to move.	If you lean too far over sideways in a corner you can lose your balance and tip over sideways. It's like a centrifugal force. You have to stay balanced with steady throttle, and use momentum to keep you up. Kind of like spinning a bucket of water around in a circle, or a swing.	The higher you go on a jump the harder the landing is. Try to land on a downward slope to reduce the impact. Flat landings are harsh.	If you jump into the whoops instead of roll into the whoops, the gravity will smash you down into the whoops. You can double double the whoops by jumping, or skim the tops of the whoops and smash through them. Gravity is always pushing you down.

CONCLUSION:

In conclusion, after studying the science behind motocross track design, soil composition, and most common obstacles, I was able to answer my problem. By understanding scientific forces, I was able to understand the science behind proper riding technique. There are many ways to ride a motocross track most efficiently by understanding the scientific forces for each track and obstacle.

Bibliography:

I interviewed and studied data from several motocross racers and track builders including:

Spenser Wilton: Professional off road racer (coaching sessions and personal interview).

Charlie Johnston: Professional motocross racer and professional motocross track builder (interview and riding footage).

Wyatt Hasil: Alberta champion amatuer racer (best friend).

Stefan Everts: 9 time world champion mxgp racer (riding footage and personal interview).

Tell Schell Episodes: I have made 29 Tell Schell episodes on my Instagram and interview racers often.

And Mitch Robinson